

**WE CLAIM:**

- 1        1. A tubular structure having an aspect ratio of about 3 or more and  
2 comprising an interior surface, said interior surface comprising a gaseous deposition  
3 product comprising a substantially uniform coating.
- 1        2. The tubular structure of claim 1 wherein said coating comprises a  
2 thickness of at least about 0.5 micrometers.
- 1        3. The tubular structure of claim 1 wherein said coating comprises a  
2 thickness of at least about 2 micrometers or more.
- 1        4. The tubular structure of claim 1 wherein said coating comprises a  
2 thickness of at least about 5 micrometers or more.
- 1        5. The tubular structure of claim 1 wherein said coating comprises a  
2 thickness of at least about 15 micrometers or more.
- 1        6. The tubular structure of claim 1 wherein said gaseous deposition  
2 product gaseous comprises carbon.
- 1        7. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises silicon.
- 1        8. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises chromium.
- 1        9. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises aluminum.
- 1        10. The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises titanium.
- 1        11. The tubular structure of claim 1 wherein a gaseous precursor material  
2 for said gaseous deposition product comprises a diffusion pump fluid selected from

3 the group consisting of polyphenyl ether; elcosyl naphthalene; *i*-diamyl phthalate; *i*-  
4 diamyl sebacate; chlorinated hydrocarbons; *n*-dibutyl phthalate; *n*-dibutyl sebacate; 2-  
5 ethyl hexyl sebacate; 2-ethyl hexyl phthalate; di-2-ethyl-hexyl sebacate; tri-*m*-cresyl  
6 phosphate; tri-*p*-cresyl phosphate; and o-dibenzyl sebacate.

1       12.     The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises siloxane.

1       13.     The tubular structure of claim 12 wherein said siloxane is polydimethyl  
2 siloxane.

1       14.     The tubular structure of claim 12 wherein said siloxane is pentaphenyl-  
2 trimethyl siloxane.

1       15.     The tubular structure of claim 12 wherein a gaseous precursor material  
2 for said siloxane is a silicon containing diffusion pump fluid.

1       16.     The tubular structure of claim 1 wherein a gaseous precursor material  
2 for said gaseous deposition product comprises a metallic precursor.

1       17.     The tubular structure of claim 16 wherein said metallic precursor is  
2 selected from the group consisting of metal carbonyls, metal acetates, and metal  
3 alkanedionates.

1       18.     The tubular structure of claim 17 wherein said metallic precursor is  
2 metal pentanedionate.

1       19.     The tubular structure of claim 17 wherein said metallic precursor is  
2 selected from the group consisting of tetrakis(dimethylamino)titanium,  
3 hexacarbonylchromium, and hexacarbonylvanadium carbonyl.

1       20.     The tubular structure of claim 19 wherein said hexacarbonylvanadium  
2 carbonyl is selected from the group consisting of erbium III acetate, yttrium 2,4-

3 pentanedionate, erbium 2,4-pantanatedionate, and N,N-(dimethylethanamine)-  
4 trihydridoaluminum.

1        21.      The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises silane.

1        22.      The tubular structure of claim 1 wherein said gaseous deposition  
2 product comprises trimethyl silane.

1        23.      The tubular structure of claim 1 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1        24.      The tubular structure of claim 2 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1        25.      The tubular structure of claim 3 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1        26.      The tubular structure of claim 4 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1        27.      The tubular structure of claim 5 wherein said substantially uniform  
2 coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3 less along its length.

1        28.      A tubular structure having an aspect ratio of about 3 or more and  
2 comprising an interior surface, said interior surface comprising a gaseous deposition  
3 product comprising a substantially uniform amorphous carbon coating.

1           29.     The tubular structure of claim 28 wherein said coating comprises a  
2     thickness of at least about 0.5 micrometers.

1           30.     The tubular structure of claim 28 wherein said coating comprises a  
2     thickness of at least about 2 micrometers or more.

1           31.     The tubular structure of claim 28 wherein said coating comprises a  
2     thickness of at least about 5 micrometers or more.

1           32.     The tubular structure of claim 28 wherein said coating comprises a  
2     thickness of at least about 15 micrometers or more.

1           33.     The tubular structure of claim 29 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           34.     The tubular structure of claim 30 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           35.     The tubular structure of claim 31 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           36.     The tubular structure of claim 32 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           37.     The tubular structure of claim 29 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           38.     The tubular structure of claim 30 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           39.     The tubular structure of claim 31 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           40.     The tubular structure of claim 32 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           41.     The tubular structure of claim 29 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           42.     The tubular structure of claim 30 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           43.     The tubular structure of claim 31 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           44.     The tubular structure of claim 32 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           45.     A tubular structure having an aspect ratio of about 6 or more and  
2     comprising an interior surface, said interior surface comprising a gaseous deposition  
3     product comprising a substantially uniform amorphous carbon coating.

1           46.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 0.5 micrometers.

1           47.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 2 micrometers.

1           48.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 5 micrometers.

1           49.     The tubular structure of claim 45 wherein said coating has a thickness  
2     of at least about 15 micrometers.

1           50.     The tubular structure of claim 46 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           51.     The tubular structure of claim 47 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           52.     The tubular structure of claim 48 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           53.     The tubular structure of claim 49 wherein said substantially uniform  
2     coating comprises a coating thickness comprising a uniformity of about +/- 20% or  
3     less along its length.

1           54.     The tubular structure of claim 46 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           55.     The tubular structure of claim 47 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           56.     The tubular structure of claim 48 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           57.     The tubular structure of claim 49 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           58.     The tubular structure of claim 46 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           59.     The tubular structure of claim 47 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           60.     The tubular structure of claim 48 wherein said coating comprises a  
2       hydrogen concentration of about 32 %.

1           61.     The tubular structure of claim 49 wherein said coating comprises a  
2       hydrogen concentration of about 32 %.

1           62.     The tubular structure of claim 45 comprising said interior surface  
2       comprising at least one metal, and comprising a sequential gradient towards a center  
3       of said tubular structure comprising:

4                 silicon chemically bonded to said metal, forming a metal-silicide;

5                 silicon cohesively bonded to said metal-silicide;

6                 carbon chemically bonded to said silicon, forming silicon-carbide; and

7                 carbon cohesively bonded to said silicon-carbide forming said substantially

8                 uniform carbon coating.

1           63.     The tubular structure of claim 45 comprising said interior surface  
2       comprising at least one metal, and comprising a sequential gradient towards a center  
3       of said tubular structure comprising:

4                 germanium chemically bonded to said metal, forming a metal-germanide;

5                 germanium cohesively bonded to said metal-germanide;

6                 carbon chemically bonded to said germanium, forming germanium -carbide;

7       and

8                 carbon cohesively bonded to said germanium -carbide forming said  
9                 substantially uniform carbon coating.

1           64.     The tubular structure of claim 62 wherein said coating has a thickness  
2       of at least about 0.5 micrometers.

1           65.     The tubular structure of claim 62 wherein said coating has a thickness  
2     of at least about 2 micrometers or more.

1           66.     The tubular structure of claim 62 wherein said coating has a thickness  
2     of at least about 5 micrometers or more.

1           67.     The tubular structure of claim 62 wherein said coating has a thickness  
2     of at least about 15 micrometers or more.

1           68.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises carbon.

1           69.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises silicon.

1           70.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises chromium.

1           71.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises aluminum.

1           72.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises titanium.

1           73.     The tubular structure of claim 62 wherein a gaseous precursor to said  
2     gaseous deposition product comprises a diffusion pump fluid selected from the group  
3     consisting of polyphenyl ether; elcosyl naphthalene; *i*-diamyl phthalate; *i*-diamyl  
4     sebacate; chlorinated hydrocarbons; *n*-dibutyl phthalate; *n*-dibutyl sebacate; 2-ethyl  
5     hexyl sebacate; 2-ethyl hexyl phthalate; di-2-ethyl-hexyl sebacate; tri-*m*-cresyl  
6     phosphate; tri-*p*-cresyl phosphate; and o-dibenzyl sebacate.

1           74.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises a siloxane.

1           75.     The tubular structure of claim 64 wherein said siloxane is  
2     polydimethyl siloxane.

1           76.     The tubular structure of claim 64 wherein said siloxane is pentaphenyl-  
2     trimethyl siloxane.

1           77.     The tubular structure of claim 64 wherein said siloxane is a silicon  
2     containing diffusion pump fluid.

1           78.     The tubular structure of claim 62 wherein a gaseous precursor to said  
2     gaseous deposition product comprises a metallic precursor.

1           79.     The tubular structure of claim 78 wherein said metallic precursor is  
2     selected from the group consisting of metal carbonyls, metal acetates, and metal  
3     alkanedionates.

1           80.     The tubular structure of claim 79 wherein said metallic precursor is  
2     metal pentanedionate.

1           81.     The tubular structure of claim 79 wherein said metallic precursor is  
2     selected from the group consisting of tetrakis(dimethylamino)titanium, chromium  
3     carbonyls (hexacarbonylchromium), vanadium carbonyls (hexacarbonylvanadium  
4     carbonyl).

1           82.     The tubular structure of claim 81 wherein said hexacarbonylvanadium  
2     carbonyl is selected from the group consisting of erbium III acetate, yttrium 2,4-  
3     pentanedionate, erbium 2,4-pantanatedionate, and N,N-(dimethylethanamine)-  
4     trihydridoaluminum.

1           83.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises silane.

1           84.     The tubular structure of claim 62 wherein said gaseous deposition  
2     product comprises trimethyl silane.

1           85.     The tubular structure of claim 64 wherein said coating thickness  
2     comprises a uniformity of about +/- 20% or less along its length.

1           86.     The tubular structure of claim 65 wherein said coating thickness  
2     comprises a uniformity of about +/- 20% or less along its length.

1           87.     The tubular structure of claim 66 wherein said coating thickness  
2     comprises a uniformity of about +/- 20% or less along its length.

1           88.     The tubular structure of claim 67 wherein said coating thickness  
2     comprises a uniformity of about +/- 20% or less along its length.

1           89.     The tubular structure of claim 85 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           90.     The tubular structure of claim 86 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           91.     The tubular structure of claim 87 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           92.     The tubular structure of claim 88 wherein said coating comprises a  
2     nanohardness of about 15 GPa measured using a nano-indentation hardness tester.

1           93.     The tubular structure of claim 85 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           94.     The tubular structure of claim 86 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           95.     The tubular structure of claim 87 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.

1           96.     The tubular structure of claim 88 wherein said coating comprises a  
2     hydrogen concentration of about 32 %.